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JOHN MACOUN MEMORIAL.

At the request of naturalists generally throughout Canada, the Ottawa Field-Naturalists' Club has decided to receive subscriptions for a permanent memorial in honor of the late Prof. John Macoun, Naturalist of the Geological Survey of Canada, who died at Sidney, B. C., on July 18, 1920.

The wide field of natural history work to which John Macoun devoted his life is well known, not only throughout Canada but in other countries as well. He specialized particularly in botany and was the founder of the Canadian National herbarium. Other sciences, however, especially zoology, were also greatly enriched by him; he will always be remembered as a great pioneer in Canadian natural history.

Many friends of the late John Macoun, particularly in Toronto and Ottawa, have thought that the memorial should take the form of a painted portrait to be hung in the Victoria Memorial Museum. Such a memorial has now been decided upon and a painting will be made by Mr. Franklin Brownell of Ottawa, the well-known portrait painter. Expenses in connection therewith will be about $700.

Subscriptions to this fund should be forwarded to Mr. Arthur Gibson, Dominion Entomologist, Ottawa.

Should the list be oversubscribed arrangements may be made whereby those subscribing above a certain sum, which now cannot be defined, will receive a reproduction of the painting.

A. G.

POPULAR AND PRACTICAL ENTOMOLOGY.

PARASITES OF THE PALE WESTERN CUTWORM IN ALBERTA.

BY E. H. STRICKLAND,
Entomological Branch, Ottawa.*

The pale western cutworm, *Porosagrotis orthogonia* Morr., has been, since 1911, the most destructive insect pest of grain crops in southern Alberta and in a small area of south western Saskatchewan.

The damage in some years amounts to considerably over a million dollars, and all control measures so far employed have proved to be unsuccessful when they are applied to large areas of infestation. For this reason natural control is of superlative importance.

The larvæ of this species are almost entirely subterranean in their habits, and they are never seen above ground by daylight. Hence they are practically immune from destruction by the all too scarce prairie birds. Some fall prey to predators such as *Calosoma frigidum* Kby. and *Ammophila* species, but these represent a very small percentage. No signs of disease have been observed, the

* Contribution from the Entomological Branch, Dept. of Agriculture, Ottawa.

winter is passed in the egg stage which appears to be little affected by freezing, and the larvæ cannot be drowned, even with excessive irrigation.

Although the species occurs throughout the Great Basin region of the United States, in which it is recorded from five States, it has never appeared there in destructive numbers. Recently it has increased in Montana to an alarming extent.

In the Montana Agricultural Station Circular No. 94, (1920) the statement is made that the "pale western cutworm, remaining as it does below the surface of the ground, is protected from the attacks of parasitic insects." The absence of parasites in this species in Montana has been commented upon in correspondence to the writer both by Professor Cooley, and Mr. J. R. Parker.

This condition is very much at variance with that experienced in Alberta, where parasites are of great importance, and significance. We are able, in most seasons, to predict the severity of outbreaks by a study of the parasite conditions of the previous year in infested districts. Extensive notes have been made on the biology of several of these parasites, but they are still too incomplete for publication.

The following species have been bred in considerable numbers:—

YEAR	HYMENOPTERA	TACHINIDAE.	ADULT MOTHS	CLIMATIC CONDITIONS
1913	*Zele* Sp. 1. Specimen.	*Bonneto comta* 2.5% *Gonia capitata* 39.0%	?	Medium
1914	*Zele* Sp. 2.0% *Met. dimidiatus* 2.0%	*G. capitata* (minimum) 43.0%	5.0%	Drought
1915	*Met. dimidiatus* 2 0% (estimated)	*G. capitata* (min) 7.5% *B. comta* (min) 11.0%	13.0%	Wet
1919	*Met. dimidiatus* 10.0%	No record. *Gonia capitata* about 5.0%	?	Dry
1920	*Met. dimidiatus* 50.0%	Records incomplete	?	Dry

The figures given for Hymenoptera are those obtained by dissection, as are those for Tachinids other than in the years 1914 and 1915. During these years full grown larvae were placed in breeding cages in June and records were kept of the adult moths and parasites that emerged in the fall and following Spring. From the low numbers of cutworms accounted for in these breeding cages,—52% and 33% respectively,—it can be assumed that the actual parasitism was considerably higher than the figures indicate.

Other species bred in small numbers are:—*Peleteria robusta*, Wied. 1913. and *Ernestia radicum* Fab. 1916. Both are Tachinids.

The habits of the more important parasites are briefly as follows:—

Meteorus dimidiatus Cress. (Teste Brues).

Two generations per annum. Hibernate as larvae in overwintering cutworms, such as *Euxoa tristicula* Morr. Adults emerge in May, and parasitize *P. orthogonia* and other Noctuidae. The female lays about twelve eggs in each host. Our records of the date of appearance of the second generation adults indicate a considerable variation from year to year, but the majority have emerged in July.

On account, it is thought, of the underground habits of *P. orthogonia* the percentage of infestation by this Braconid is never as high as it is in the Euxoas, but it is of interest to note that we have bred it from *Sidemia devastator* Brace, a species of cutworm that has never been recorded as coming to the surface.

Gonia capitata DeGeer, and other Species. (Teste Tothill).

At least two closely allied species of Tachinidae, with similar habits, are included here. The only differences that we have been able to detect are slight variations in larval and adult structures. We have found three types of stage 1 larvae. All of the species have one generation per annum. They hibernate as puparia. The adult emerges in May, and lays thousands of minute eggs on vegetation. When eaten by cutworms these eggs hatch and the escaping larvae mature at about the time that the host pupates. They transform into the hibernating puparium either in the soil, or in the dead larva or pupa of their host.

The selection of vegetation by the fly, and the location of the eggs on selected plants, plays an important role in the value of the parasite.

We have found the most abundant oviposition on the blades of Blue-joint (*Agropyron Smithii.*) though it is frequent on other native grasses, and to a slightly less extent on imported graminae, including grain crops. Native dicotyledons may carry a few eggs, but we have never found them on introduced plants belonging to this class.

Unfortunately *P. orthogonia* does not feed readily upon Blue-joint and we did not find that *G. capitata* selected the lower portions of the plants for oviposition in preference to the upper. The high percentage of parasitism is rather remarkable since *P. orthogonia* feeds almost entirely below the ground. It would appear, however, that periods of drought are beneficial to this parasite since the reduced growth of vegetation necessitates a more abundant oviposition on available plants.

Bonneta comta Wied. (Teste Tothill).

Very little is known of the life history of this species. The adult appears in July and August, and it belongs to the group of Tachinidae that are larviparous. It is probably, therefore, double brooded, though it has not been bred from overwintering species of cutworms. Regarding the selection of plants for the supposed larviposition the following figures, obtained in 1915, are of interest.

P. orthogonia larvae collected from Spring Wheat were 21% parasitized.

P. orthogonia larvae collected from Fall Wheat were 2% parasitized.

P. orthogonia larvae collected from Alfalfa were 0% parasitized.

This suggests a similar habit to that of *Gonia capitata* in the selection of plants.

With a more complete knowledge of the habits of these parasites, particu-

larly of the Tachinids, it may be possible to encourage their increase by the selection of favorable crops, and a consideration of the most advantageous dates of seeding.

PSITHYRUS LABORIOSUS FABR. IN THE NESTS OF BUMBLEBEES (HYM).

BY THEODORE H. FRISON,
Urbana, Illinois.

Of the nine or possibly ten species of the genus *Psithyrus* occurring in America, North of Mexico, only two have ever been recorded from the nests of bumblebees. When Franklin's work on "The Bombidae of the New World" appeared in 1913, there had not been recorded a single authentic instance of a *Psithyrus* having been taken in a bumblebee's nest in this country. The fact that many American writers had mentioned the inquiline habits of *Psithyrus* was entirely due to the numerous European records on the subject.

Mr. F. W. L. Sladen in the Canadian Entomologist for March, 1915, was the first to record the finding of a species of *Psithyrus* in a *Bremus* (*Bombus*) nest in the Nearctic region. In this article he reports the discovery of *Psithyrus insularis* Sm. in the nest of *Bremus* (*Bombus*) *flavifrons* Cress. on July 7, 1914 at Agassiz, British Columbia. In April, 1916 in the Bulletin of the Brooklyn Entomological Society, the writer recorded the presence of *Psithyrus variabilis* Cress. in the nests of *Bremus pennsylvanicus* DeGeer in the summer of 1910 and 1915 at Champaign, Illinois. Several times since then, both in 1917 and 1920, I have taken *Psithyrus variabilis* Cress. in the nests of *Bremus pennsylvanicus* DeGeer.

On July 22, 1919 I removed to the laboratory for closer study a nest of *Bremus* (*Bombus*) *pennsylvanicus* DeGeer. This nest was one of several started in domiciles I had buried in the ground for attracting searching bumblebee queens. The domicile was first noted as being inhabited on June 20, when it contained a small honey-pot and eggs. As the queen was not in the nest I was unable to determine the species at this time (June 20). On July 22, when I removed the nest, it contained a queen and four small workers of *Bremus pennsylvanicus* DeGeer., besides five egg cells containing eggs, two brood masses, and fifteen pupal cocoons. In the nest material near the entrance were the remains of a queen of *Bremus pennsylvanicus* DeGeer and a queen of *Psithyrus laboriosus* Fabr. The two dead queens were mute testimony of the earlier history of this colony. Evidently after the nest was started another queen of *Bremus pennsylvanicus* DeGeer found it, and a struggle ensued over the possession of the nest. Such fighting over the nests is very common in late spring and early summer. Which queen finally won and stung the other to her death is an open question. The dead *Psithyrus* queen can only be accounted for in much the same manner, and all this goes to show that a *Psithyrus* queen is not always peaceably admitted into a bumblebee nest or victorious in a battle with the *Bremus* queen. The history of this colony was followed until September 16, and no *Psithyrus* were ever reared from the nest.

In a nest of *Bremus* (*Bombias*) *auricomus* Robt., about one and one-half

feet below the surface of the ground, examined on July 26, at Clyman Junction, Wisconsin, I found a queen of *Psithyrus laboriosus* Fabr. In this instance also, the *Psithyrus* queen had evidently been stung by the queen bumblebee. When the *Psithyrus* queen was handled, it was barely able to move a leg, and acted in every respect like a bumblebee that had been stung. It was in the nest material near the entrance of the nest, probably having been dragged there by the *Bremus* queen. In the nest at the time, besides these two queens, were twelve workers, fifteen eggs, and some larvae and pupae. It was impossible to make a detailed study of the development of this colony in order to learn if any individuals of *Psithyrus* were eventually produced.

Whether any of the Nearctic species of *Psithyrus* are restricted to the nests of one particular species of *Bremus* or not is still to be decided. Sladen in the previously mentioned article, infers that *Psithyrus insularis* Sm. must at least frequent the nest of another species of bumblebee besides *Bremus flavifrons* Cress., as *Psithyrus insularis* Sm. occurs at Ottawa, Ontario where *Bremus flavifrons* Cress. is not indigenous. From the evidence given above, *Psithyrus laboriosus* Fabr. evidently invades the nests of both *Bremus pennsylvanicus* DeGeer and *Bremus auricomus* Robt., species representing the two subgenera of *Bremus*. If *Psithyrus laboriosus* Fabr. will enter the nests of two such widely separated species as these, it is reasonable to assume that it will frequent the nest of almost any species of bumblebee within its range. About Urbana, Illinois, where *Psithyrus variabilis* Cress. is very common, I have never found it in the nests of any bumblebee species but *Bremus pennsylvanicus* DeGeer, and it remains for future investigation to decide whether *Psithyrus variabilis* Cress. has more than one host.

Edward Saunders in "The Hymenoptera of the British Islands" says that the species of *Psithyrus* appear not always to confine themselves to the same host. Hoffer, one of the closest students of the European *Bremidae*, reports finding *Psithyrus campestris* Panz. in the nests of *Bremus agrorum* Fabr., *B. silvarum* Linn., and *B. variabilis* Schmied. *Psithyrus rupestris* Fabr. and *P. vestalis* Fouc., however, are apparently very closely associated with *Bremus lapidarius* Linn. and *B. terrestris* Linn. Even these last two species of *Psithyrus*, as shown by Sladen in "The Humble-bee" occasionally lodge in a nest of another species of bumblebee.

NOTES ON THE PREPARATORY STAGES OF GNOPHAELA VERMICULATA G. AND R.

BY F. C. WHITEHOUSE.
Red Deer, Alta.

Mid-June 1919 I took some nearly full grown larvae of this species in a tamarack swamp near Red Deer, which pupated about a week later and emerged 11th to 14th July. The larvae were feeding on the borage *Mertensia virginica*. I wrote Dr. McDunnough inquiring if the life history were known, and received reply that the full grown larvae had been twice described in Entomologica Americana IV, 24 and V. 57 but that he had no knowledge of any published notes on the egg or early larval stages. He was kind enough to send me copies of the descriptions referred to.

On 31 July I received from Mrs. W. A. Cassels from Sylvan Lake, Alberta, a female moth and eggs.

Egg—The eggs, 19 in number were laid in rows close together but not touching. In shape round, except at the flattened base. Diameter approximately 1mm. Surface smooth, infinitesimally pitted. Colour rich yellow. Period of incubation (from eggs obtained later) ten days.

6th August, 9 pm: the eggs less yellow, with the black heads of the embryo larvae clearly defined at top: movement of heads noticeable, and also opening and closing of mandibles and protrusion and contraction of mouth-parts. Eggs circumscribed with two or three strands of long black hairs.

7th August 4.30 pm: three larvae hatched, the number by 9 pm. being increased to ten, by 10 p.m. to thirteen, and the balance by morning. Exit obtained by larva eating the shell immediately above head to requisite size for body to pass through. The newly emerged twist and stretch themselves, and take a short respite, after which they make their first meal under new conditions on the empty egg shells, feeding indiscriminately, two or three often at work on the same shell, and even in some instances, endeavouring to get at the broken edge of an egg through which another was hatching.

Larva Stage 1. Length about 2mm. Head black approximately the same width as the body. Colour of body, including tubercles and legs, entirely yellow Tubercles prominent; setae black, very long—say two to three times diameter of body.

Two or three hours after hatching the ground colour of body has become dirty yellow, and the tubercles, shield on first thoracic segment, and legs, glossy black—the change first noticeable on thoracic shield and fore legs. The tubercles on the abdominal segments 1-8, dorsal view, are situated as follows—a pair anteriorly, and a pair widely separated posteriorly—the four forming a crescent. There are also three or four tubercles on the sides of each segment. Thoracic segments 2 and 3 and abdominal segment 9, dorsal view, have double or twin tubercles widely separated in place of the two pairs of the other segments as above described. The twin tubercles have two hairs, and the oblong shield on thoracic segment 1, four short setae.

8th August. By the evening larvae commenced feeding on the upper and lower surfaces of the leaves of the food plant, leaving the tissue.

10th August. Length 5 mm. A double row of light brown blotches each side of the dorsum and another low down on the sides; the ground colour of the dorsum and sides is now greenish yellow.

14th August. Larvae off their feed all day and by the evening of 15th all have moulted. Length 6-7 m. Appearance radically changed: tubercles larger and bristling with short glossy black setae in place of long single or double hairs of prior stages. Ground colour of dorsum and sides yellow, irregular brown blotches connecting tubercles on either side of dorsum. Head brown.

22nd August. Length 8-9 m. The irregular brown blotches have darkened and extended on the sides—the yellow being less discernible. The yellow dorsal stripe remains, posteriorly broad enough to include the pair of tubercles referred to previously, and again widening at the base of each segment.

27th August. Second moult occurred. Length 9m. Sides mottled brown and yellow: dorsum yellow. Tubercles, from being black, have taken on the metallic-blue luster of the final larval stage; the head, likewise, has assumed the bright chestnut red of the full grown larva; in fact the general appearance is now that of the mature larva prior to pupation.

Absent from home 30th August to 23rd September, and no material change noticeable on my return. Found several larval skins and assume that at least one further moult had taken place. Length still 9m.

29th Sept.—2nd Oct, Another moult.

3rd—11 Oct. Weather cold, snow, and as much as 22 degrees of frost. The leaves of the food plant decayed and turned brown, both in the feeding bottle and in nature. Clearly hibernation must now occur.

12th Oct. Fourteen of the larvae still alive; went to earth.

My material did not re-appear in the Spring, so the satisfaction of rearing the species from egg to moth was not realized. My memoranda would however serve to show that there are at least four moults prior to hibernation; that after the second moult the general appearance is very much that of the full grown larvae, and that the pre-hibernation growth is remarkably slow and retarded—though there is the possibility of this being attributable to captivity to some degree.

I realize that, from the specialist's point of view, the above account leaves much to be desired as to specificness (and probably accuracy) of detail. It is only supposed to be the story of the early stages of the insect as seen by a collector.

A SYNOPSIS OF THE NORTH AMERICAN SPECIES OF THE GENUS HELINA R.-D., SENS. LAT. (DIPTERA, ANTHOMYIIDAE).

BY J. R. MALLOCH,
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The forty species included in the present synopsis belong to several closely allied genera, *Helina, Hebecnema, Spilaria, Xenomydaea,* and *Enoplopteryx*. All of the species would fall within the limits of Stein's genus *Mydaea* but they are undoubtedly a conglomerate group and it is in my opinion necessary to separate the component parts at least as subgenera though I incline to the opinion that they are really entitled to full generic rank. The distinguishing characters of the groups are dealt with in several of my recently published papers on the family and will be summarised in a generic synopsis which is now in manuscript.

KEY TO SPECIES.

MALES.

1. Hypopleura with fine erect hairs usually in a more or less vertical series below middle of spiracle or near posterior margin; eyes with long hairs; prealar bristle short but distinct; scutellum with the setulose hairs continued downward on lateral margins and at times slightly invading ventral surface; basal abdominal sternite with a few hairs.... (*Spilaria*) 2.

— Hypopleura with a few long hairs on upper margin in front of spiracle; sides and ventral surface of scutellum bare; first abdominal sternite

bare.....(Gen. n.) *marmorata* Meigen?

— Hypopleura bare; if with a few hairs below spiracle the sides and ventral surface of scutellum are bare; first abdominal sternite sometimes with a few hairs.....4

2. Hind femur with a few bristly hairs at apex on posteroventral surface, none of which are nearly as long as the diameter of femur where they are situated; eyes densely long haired, separated by a little more than width of anterior ocellus.....*multisetosa* Schnabl

— Hind femur with a number of bristles at apex on posteroventral surface, most of which are distinctly longer than diameter of femur where they are situated.....3.

3. Eyes densely long haired, separated by a little more than width of anterior ocellus; black species, more or less densely gray pruinescent, but the dorsum of thorax always shining.....*lucorum* Fallen

— Eyes rather sparsely haired, separated by distinctly more than the width across posterior ocelli; black species, the entire body densely gray pruinescent, the dorsum of thorax not distinctly shining.....*punctata* Stein

4. Legs entirely black.....5

— Legs partly yellowish or reddish.....13

5. Eyes separated by nearly one third of the head-width; mid tibia with two very strong anterodorsal bristles; hind tibia with one or two bristles near base on posterodorsal surface; first abdominal sternite setulose.....*latifrontata* Malloch

— Eyes separated by much less than one third of the head-width; mid tibia without anterodorsal bristles except in *nitida* and *nigrita*.....6.

6. Knobs of halteres black.....7.

— Knobs of halteres pale.....9.

7. Margins of calyptrae black; eyes with short hairs; arista with its longest hairs as long as width of third antennal segment; posteroventral surface of hind femur without strong bristles; basal abdominal sternite setulose.....*nitida* Stein

— Calyptrae yellowish, margins pale; eyes bare.....8.

8. Posteroventral surface of hind femur with a series of strong bristles; longest hairs on arista not longer than its basal diameter; basal abdominal sternite bare; prealar bristle moderately long.....*hannai* sp. n

— Posteroventral surface of hind femur almost bare; longest hairs on arista longer than width of third antennal segment; prealar bristle absent or minute; basal abdominal sternite bare....*Hebecnema vespertina* Fallen

9. Mid tibia with a small protuberance on posterior side beyond middle, which is covered with short setulae, and basad of the protuberance about ten long bristles on the same surface.....*tuberculata* Malloch

— Mid tibia without such protuberance and bristles.....9a.

9a. Hind femur with a series of long bristles from base to apex on anteroventral surface, the length of the bristles exceeding the diameter of femur; a few weak hairs sometimes below metathoracic spiracle; basal abdominal sternite setulose.....*nasoni* Malloch

— Hind femur with long bristles confined to apical half of anteroventral surface; basal abdominal sternite bare.....10.

10. Abdomen with a black dorsocentral vitta; eyes short haired, almost contiguous.....*Hebecnema umbratica* Meigen.

— Abdomen with paired black dorsal spots; eyes not nearly contiguous....11.

11. Thorax with three pairs of postsutural dorsocentral bristles; hind femur with antero-and posteroventral bristles; mid tibia with two weak anterodorsal bristles..... ...*nigrite* Malloch

— Thorax with four pairs of postsutural dorsocentral bristles; posteroventral surface of hind femur and anterodorsal surface of mid tibia without bristles .....12.

12. Abdomen inconspicuously spotted; wings very conspicuously browned towards base and anteriorly; hind tibia without a bristle near base on posterodorsal surface; eyes separated by less than width across posterior ocelli.....*nigricans* Stein

— Abdomen conspicuously spotted; wings hyaline; hind tibia with a setula near base on posterodorsal surface; eyes separated by at least as great a distance as width across posterior ocelli.....*duplicata* Meigen

13. Thorax with four pairs of postsutural dorsocentral bristles.....14.

— Thorax with three pairs of postsutural dorsocentral bristles.....24.

14. Femora partly or entirely black.....15.

— Femora entirely pale.....22.

15. Eyes with dense long hairs; abdomen ovate, with dorsal paired spots and lateral checkerings.....16.

— Eyes bare or with very short sparse hairs; abdomen not as above.....19.

16. Hind femur without bristles on posteroventral surface; hind tibia with long bristles on entire length of anteroventral and posterior surfaces.....*pectinata* Johannsen

— Hind femur with long slender bristles on basal half of posteroventral surface; hind tibia not as above.....17.

17. Thorax with one pair of long presutural acrostichal bristles; lateral margins and ventral surface of scutellum bare.....*orbitaseta* Stein

— Thorax without long presutural acrostichal bristles.....18.

18. Eyes separated by about the width of anterior ocellus; ventral surface of scutellum bare.....*rufitibia* Stein.

— Eyes separated by at least the width across posterior ocelli; ventral surface of scutellum with sparse erect soft hairs.....*brevis* Stein

19. Abdomen with a distinct black dorsocentral vitta; eyes sparsely haired, almost contiguous above; hind femur without bristles on posteroventral surface except near apex.....*Hebecnema vespertina* Fallen

— Abdomen with distinct paired spots on dorsum.....20.

20. Third wing-vein bristly at base; hind tibia with a very long anterodorsal median bristle, the apical dorsal one very weak.....*Enoplopteryx anceps* Zetterstedt*

— Third wing-vein bare at base; apical dorsal bristle on hind tibia strong, nearly or quite as long as the median anterodorsal one.....21

* Recorded by Stein but probably erroneously.

21. Prealar bristle present but small; hind femur bare at middle on posteroventral surface; mid tibia without anterodorsal or posteroventral bristles; fifth sternite without strong bristles.....*duplicata* Meigen

— Prealar bristle absent or minute; hind femur with one or two strong, but not very long bristles at middle of posteroventral surface; mid tibia with one or two anterodorsal and posteroventral bristles; fifth abdominal sternite with a very strong bristle on each side of cleft.....*bispinosa* Malloch

22. Thorax shining fulvous, without conspicuous pruinescence; facets on upper half of eyes very conspicuously enlarged, the head flattened above; arista plumose.....*Hebecnema fulva* (Bigot)

— Thorax if fulvous with distinct pruinescence; facets of eyes but little enlarged above, the head not flattened; arista very short haired.....23.

23. Hind tibia with two or more anterodorsal bristles; hind femur with eight to ten bristles extending from middle to apex on anteroventral surface, the longest bristles distinctly longer than the diameter of femur.....*lysinoe* Walker

— Hind tibia with one anterodorsal bristle; hind femur with three or four short bristles at apex on anteroventral surface, none of which exceed in length the diameter of femur.....*uniseta* Stein.

24. Scutellum with a conspicuous black spot on each side at base.....*uliginosa* Fallen

— Scutellum without such spots.....25.

25. Abdomen with an indistinct black dorsocentral vitta; mid tibia with one or two anterodorsal bristles; fore tibia with two posterior bristles; basal abdominal sternite setulose.....*linearis* Malloch

— Abdomen with paired spots on dorsum which are sometimes indistinct; mid tibia almost invariably without anterodorsal bristles.....26.

26. Eyes separated by one third of the head-width; only the fore femora blackened; spots on dorsum of abdomen very indistinct .....*spinilamellata* Malloch

— Eyes separated by much less than one third of the head-width, or not otherwise as above.....27.

27. Posteroventral surface of hind femur with long hairlike bristles on almost its entire length or on basal half; posterodorsal surface of hind tibia with from one to three short setulae.....28.

— Posteroventral surface of hind femur bare or with a few bristles at middle or near apex; posterodorsal surface of hind tibia without setulae except in *abiens* and *spuria*.....30.

28. Hind tibia with long soft hairs on ventral surfaces....*consimilata* Malloch

— Hind tibia with a few small bristles on anteroventral and posteroventral surfaces, the ventral surface bare.....29.

29. Eyes separated by three times the width across posterior ocelli; legs black .....*fletcheri* Malloch

— Eyes separated by less than twice the width across posterior ocelli; tibiae and apices of femora reddish yellow.....*nigribasis* Malloch.

30. Hind tibiae with rather dense long bristly hairs on ventral surfaces....30a.
— Hind tibia without dense bristly hairs on ventral surfaces.....30b.
30a. Hind femur with some long bristly hairs on apical half of posteroventral surface; cross-veins indistinctly infuscated.....*oregonensis* Malloch
— Hind femur without long bristly hairs on posteroventral surface; cross-veins very conspicuously infuscated.....*cothurnata* Rondani.
30b. Only the fore femora blackened; palpi yellow; prealar bristle absent; cross-veins not infuscated; hind femur bare at middle on posteroventral surface.....*abiens* Stein
— All femora more or less blackened; palpi largely or entirely black; prealar bristle distinct except in *spuria*.....31.
31. Cross-veins of wings very conspicuously infuscated; hind femur bare at middle on posteroventral surface; third vein bare at base; basal abdominal sternite setulose.....*obscurinervis* Stein
— Cross-veins of wings very narrowly infuscated; hind femur with a few short bristles on middle of posteroventral surface; third wing-vein at base and basal abdominal sternite bare.....*spuria* Malloch
— Cross-veins of wings not infuscated; hind femur with two or three short bristles at middle of posteroventral surface; third vein with a few weak setulae at base above and below; basal abdominal sternite bare.....*Xenomydaea buccata* Malloch

FEMALES.

1. Hypopleura with some fine hairs below spiracle.....2.
— Hypopleura with some hairs on its upper margin in front of spiracle.....*marmorata* Meigen?
— Hypopleura bare.....5.
2. Hind tibia with three anterodorsal bristles; wing-veins 3 and 4 very decidedly divergent at apices.....*multisetosa* Schnabl
— Hind tibia with two anterodorsal bristles; veins 3 and 4 very little divergent at apices.....3.
3. Thoracic and abdominal pruinescence brownish gray; calyptrae yellowish.....*lucorum* Fallen
white.....*punctata* Stein
— Thoracic and abdominal pruinescence whitish gray; calyptrae
4. Legs entirely black, rarely with the knees reddish.....6.
— Legs with at least the tibiae of one or more pairs reddish or yellowish....
5. Mid tibia with one or more anterodorsal bristles; hind tibia with one or two posterodorsal setulae near base.....7.
— Mid tibia without anterodorsal bristles; or the hind tibia has no posterodorsal setulae near base and the arista is nearly bare.....9.
6. Ventral surface of scutellum with soft erect hairs....*hylemyioides* Malloch
— Ventral surface of scutellum bare.....7.
7. Halteres blackish brown.....*nitida* Stein.
— Halteres pale yellow.....*latifrontata* Malloch
8. Halteres black.....9.
— Halteres pale.....10

9. Arista pubescent; calyptrae with black margins....*fuscomarginata* Malloch
— Arista plumose; calyptrae entirely pale.... *Hebecnema vespertina* Fallen
10. Arista plumose; prealar bristle absent or minute; mid tibia without anterodorsal bristles.....*Hebecnema umbratica* Meigen
— Arista pubescent; prealar bristle more than half as long as the one behind it; mid tibia with one or two anterodorsal bristles..*tuberculata* Malloch
11. Thorax with four pairs of postsutural dorsocentral bristles.....12.
— Thorax with three pairs of postsutural dorsocentral bristles
12. Ventral surface of scutellum with some soft erect hairs at apex; mid tibia with several anterodorsal bristles.....*brevis* Stein
— Ventral surface of scutellum bare.....13.
13. Mid tibia with an anterodorsal bristle; mid and hind femora in part blackened.....*duplicata* Meigen
— Mid tibia without an anterodorsal bristle; mid and hind femora not blackened .....14.
14. Thorax with a very strong pair of presutural acrostichals..*orbitaseta* Stein
— Thorax without a strong pair of presutural acrostichals....*rufitibia* Stein
15. Abdomen checkered, without distinct paired dorsal spots; palpi black....16.
— Abdomen with paired dorsal black or brown spots, if the spots are indistinct the ground colour of the abdomen and sometimes of the thorax is more or less testaceous and the palpi are entirely or largely yellow.....17.
16. Antennae entirely black.....*mimetica* Malloch
— Third antennal segment conspicuously reddish yellow at base.....*johnsoni* Malloch
17. Longest hairs on arista about as long as width of third antennal segment.....*Hebecnema fulva* Bigot
— Arista much shorter haired.....18.
18. Hind tibia with one anterodorsal bristle; abdomen black, densely gray pruinescent, with black paired dorsal spots; palpi broadly infuscated at apices.....*uniseta* Stein
— Hind tibia with two anterodorsal bristles; abdomen more or less testaceous, gray pruinescent, with poorly defined brown paired spots on dorsum; palpi entirely yellow.....*lysinoe* Walker
19. Scutellum with a conspicuous black spot on each side at base.....*uliginosa* Fallen
— Scutellum without such spots.....20.
20. Third wing-vein with a few weak setulae at base above and below.....*Xenomydaea buccata* Malloch
— Third wing-vein bare at base.....21.
21. Wings with the cross-veins very conspicuously infuscated; hind tibia without posterodorsal setulae near base.....22.
— Wings with the cross-veins not or but slightly infuscated, or the hind tibia has one or more posterodorsal setulae near base.....24.
22. Thorax entirely yellowish testaceous; head and abdomen fuscous; arista with its longest hairs distinctly shorter than width of third antennal segment.....*bicolorata* Malloch

— Thorax largely or entirely blackish.....23.

23. Arista with its longest hairs about equal in length to width of third antennal segment; hind femur with one or two long bristles at middle on posteroventral surface.....*obscurinervis* Stein

— Arista with its longest hairs about as long as its basal diameter; hind femur without bristles at middle on posteroventral surface.....*neopoeciloptera* Malloch

24. Hind tibia with one setula near base on posterodorsal surface.....sp.

— Hind tibia with three or four setulae on posterodorsal surface.....25.

25. Only the fore femora infuscated; antennae with second segment and base of third ferruginous; longest hairs on arista longer than width of third antennal segment; fore tibia with one posterior bristle; mid tibia without an anterodorsal bristle.....*abiens* Stein

— Mid and hind femora as well as fore pair infuscated at bases; antennae entirely black; longest hairs on arista a little shorter than width of third antennal segment; fore tibia with one anterodorsal and usually two posterior bristles; mid tibia with an anterodorsal bristle.....*nigribasis* Malloch

— Only the fore femora infuscated; antennae with second segment reddish; longest hairs on arista distinctly shorter than width of third antennal segment.....*spuria* Malloch

Helina hannai sp. n.

Male and Female.—Black, almost glossy. Orbits and cheeks with white pruinescence, frontal stripe opaque black; antennae and palpi black. Thorax indistinctly trivittate. Abdomen with brownish gray pruinescence, and a continuous dorsocentral black vitta. Legs black. Wings slightly fuscous, bases of veins yellow. Calyptrae bright yellow. Knobs of halteres black.

Eyes of male separated by about one tenth of the head-width; arista very pubescent; eyes almost bare. Thorax with 4 pairs of postsutural dorsocentral bristles; prealar bristle long. Abdomen subcylindrical, slightly tapered at apex; hypopygium small. Fore tibia with two or three setulae on posteroventral surface; mid tibia with two posterior bristles; hind tibia with two anterodorsal and two anteroventral bristles; hind femur with a continuous series of long bristles on anteroventral surface and some on basal half of posteroventral.

Female.—Frons over one third of the head-width; arista pubescent as in male.

Length, 6.5—7.5 mm.

Type.—St. George Island, Behring Straits, June 24, 1914. Allotype and two paratypes, same data as type; one male paratype and puparium, same locality, June 20, 1913; one male, June 10, 1914; one male and two females, June 17, 1914 (G. D. Hanna).

Named in honor of the collector.

Type in collection of United States Bureau of Biological Survey.

A FURTHER COMPARISON OF THE WINGS OF ZORAPTERA, PSOCIDS, AND APHIDS, FROM THE STANDPOINT OF PHYLOGENY.

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The venation of the fore wings of the Zoraptera, Psocids, Aphids, and related forms was discussed in a recent paper published in Vol. 32, p. 97, of the Entomological News for 1921; but the venation of the hind wings of these insects was not included in the paper referred to above, since material suitable for determining the homologies of the peculiar venation of the hind wings of the Zoraptera was not available at that time. Recently, however, through the kindness of Mr. Nathan Banks, I have been able to study the venation of the aberrant psocids figured by Enderlein 1903-1906, which have enabled me readily to homologize the veins of the hind wing of Zoraptera; and since Enderlein's principal paper was published in a Hungarian periodical which is doubtless inaccessible to many cisatlantic entomologists, I have included in the present paper such of Enderlein's figures as are of value for determining the homologies of the veins of both wings in the Zoraptera, and for determining the closest affinities of these insects. For the privilege of studying the wings of the intensely interesting and phylogenetically important order Zoraptera, I am indebted to the kindness of Mr. A. N. Caudell whose sympathetic interest, and unfailing readiness to lend assistance, has been a source of inspiration and encouragement to many a student in the field of entomological research.

The affinities of the Zoraptera have been discussed by Silvestri, 1913, Caudell, 1920, and Crampton, 1920, and all of these investigators were apparently impressed by the resemblance of the Zoraptera to the Isoptera in their general appearance, their colonial habits, the breaking off of the wings, and in certain details of thoracic and abdominal structures. I have emphasized the fact, however, that the Zoraptera are strikingly like the ancestors of the Psocids, and in an article published in Vol. 32, p. 97, of the Ent. News I have grouped the Zoraptera, Psocids, Mallophaga, Anopleura, Thysanoptera, Palaeohemiptera, Homoptera and Hemiptera, etc., in a common super-order, the "Panhomoptera" (instead of grouping the Zoraptera with the Isoptera, as in former papers) and likewise called attention to the fact that "the resemblance of both fore and hind wings of the Psocid *Archipsocus textor* to the wings of the Zoraptera is strikingly close." In the present paper, I would present the evidence of the wing veins supporting the contention that the Zoraptera are nearer to the Psocids than to any other insects; and that the Zoraptera should therefore be placed in the super-order Panhomoptera next to the Psocid members of this group; and I would also call attention to the fact that the wings of the Zoraptera are very suggestive of those of the Hymenoptera in certain respects—a resemblance which likewise extends to certain of the body structures as well.

So far as the wings are concerned, the resemblance between the Zoraptera and the Psocids is so marked, that they might readily be grouped in the same order, if the wings were the only features to be considered, since the wing venation of the Psocid sub-family Archipsocinae is even more like that of the Zorap-

tera than it is like that of many other insects grouped with them in the order Psocida, and the range of variation in the wing venation of members of this order covers far greater differences of venation than that between the Psocid group Archipsocinae and the Zoraptera. The genitalia of the Zoraptera, however, are quite different from the genitalia of the Psocids, the Zoraptera have well developed cerci, which are absent in all Psocids of which I have any knowledge, the head is of a more primitive type (and the mouthparts also) in the Zoraptera, as is also true of the thoracic sclerites of the sternal and pleural regions, and many other features, which would preclude our placing the Zoraptera in the same order with the Psocids, although the relationship between the two groups is far closer than has hitherto been supposed to be the case.

The fore wing of *Archipsocus brasilianus* shown in Fig. 10, Plate III, is strikingly similar to that of *Zorotypus snyderi* shown in Fig. 12, since in both insects, the cubitus is two-branched (i.e. it divides into "Cu_1" and "Cu_2"), while the median vein "M", is unbranched and bends upward toward "R_S" very abruptly, forming a slight connection with the latter, before bending down again toward the posterior margin of the wing. Vein "R_S" is very similar in both insects, and a comparison of Fig. 12 with Fig. 10 would indicate that in *Zorotypus snyderi* (Fig. 12) vein "R_{4+5}" has become lost, while only the branch "R_{2+3}" of the two branches of "R_S" present in Fig. 10, persists to form the terminal portion of the vein labeled "R_S" in Fig. 12 i.e. the portion labeled "R_{2+3}" in Fig 12). The pterostigma "ps" is very similar in both insects, and the fore wings of *Zorotypus snyderi* and *Archipsocus brasilianus* exhibit so many tendencies in common in their modifications, that one cannot escape the conclusion that the two insects are extremely closely related.

In Archipsocus brasilianus (Fig. 10) as in *Zorotypus snyderi* (Fig. 12) vein "M" of the fore wing is barely connected with "R_S"; but in *Archipsocus recens* (Fig. 9) vein "M" of the fore wing has coalesced with vein "R_S" for a considerable distance to form "R_S+ M", and the same is true of the fore wing of *Zorotypus hubbardi* shown in Fig. 11. We thus have the modificational tendencies exhibited by the fore wing of *Archipsocus brasilianus* repeated in the Zorapteron *Zorotypus snyderi,* while the modificational tendencies exhibited by the fore wing of *Archipsocus recens* are repeated in the Zorapteron *Zorotypus hubbardi;* and anyone who will compare the fore wings in the two groups of insects must be impressed with the remarkable similarity between the two types of wings.

The resemblance between the hind wings of the Zoraptera and Psocids is no less remarkable than the resemblances exhibited by the fore wings in the two groups of insects. Thus, in the hind wing of *Zorotypus snyderi* shown in Fig. 3 (which is almost exactly like that of *Zorotypus hubbardi*), vein "R_{2+3}" is almost an exact counterpart of vein "R_{2+3}" in Fig. 5 of the hind wing of *Archipsocus recens,* as is also true of vein "M_2" in both insects. Vein "R_S" has united with "M" and with "M + Cu" for a greater distance in the insect shown in Fig. 3 than in the insect shown in Fig. 5, and the small cell just below the label "R_S" in Fig. 5, has become obliterated in Fig. 3; but the cubitus "Cu_2" is much the same in the two insects,although the anal lobe "al" of Fig. 5, is not represented

in Fig. 3, nor is vein "R_1" of Fig. 5 represented in Fig. 3. The differences between the two types of wings are very slight, when one takes into consideration the fact that they belong to insects grouped in separate orders, and the wing of the Zorapteron shown in Fig. 3, is actually more like the Psocid shown in Fig. 5, than this Psocid is like many other members of its own order of insects (the Psocida), as one may readily see by comparing it with *Cymatopsocus opalinus* and similar Psocids. At any rate, it is a comparatively simple matter to homologize the veins of the Zorapteron wing shown in Fig. 3, with the veins of the Psocid wing shown in Fig. 5, and by working back to the intermediate type of venation exhibited by the wing shown in Fig. 6, we have a connecting link passing over into the more typical venation of the order.

Veins "R_{3+5}" and "R_{4+5}" are distinct in the wing of *Psyllipsocus ramburi* shown in Fig. 6; but in the hind wing of an aberrant form of this species, figured by Enderlein, 1903, these two veins have united almost completely (they are separate only near the margin of the wing, and for a very short distance) which suggests that the vein labeled "R_{3+5}" in Fig. 5, represents the fusion product of veins "R_{3+5}" and "R_{4+5}" of Fig. 6. Similarly, the vein labeled "M_2" in Fig. 5, probably represents the fusion product of veins "M_1" and "M_2" of Fig. 6, and the same holds true for the venation of the wing shown in Fig. 3, which is homologous with the venation of the wing shown in Fig. 5. The discal cell below the label "R_5" in Fig. 5 is represented by a similar cell below the letter "R" in Fig. 6 (this cell has become obliterated in Fig. 3); but the longitudinal vein "R_4" of Fig. 5 has assumed a more vertical position in Fig. 6, in which the vein labeled "R_3" may represent only a portion of vein "R_3" of Fig., 5, or the latter vein may have coalesced with the veins behind it, save for its terminal portion which remains free to form the vein labeled "R_3" in Fig. 6. The Vein "Cu_2" of Fig. 5, is evidently the homologue of the vein labeled "Cu_2" in Fig. 6, and it is quite impossible that vein "Cu_1" has united with "Cu_2" to form the single vein labeled "Cu_2" in both figures, although there is not positive evidence available to determine this point; and it is also quite possible that the vein labeled "Cu_2" represents only the second branch of cubitus, the first branch (i.e. "Cu_1") having faded out, or become lost in some such fashion. When a wider series and more intermediate forms of Psocids have been studied, these points may be determined with more certainty, although an examination of the tracheation of the insects in question would likewise throw much light upon the matter, if one could procure fresh material for study. These points, however, are of minor importance, and so far as the principal longitudinal veins are concerned, it is a comparatively simple matter to determine their homologies in the Zoraptera and Psocids, the only matter of uncertainty being to determine which of the branches of these longitudinal veins are lost, or unite with other branches to form the terminal portions of the longitudinal veins.

The hind wing of the Aphid shown in Fig. 1 is rather suggestive of the hind wing of the Zoraptera (Fig. 3) in its venation. The vein "Cu_2" of Fig. 1, however, is situated further (distally) from the base of the wing and is proportionately much longer than vein "Cu_2" of Fig. 3, and vein "R_2" is bent abruptly forward in Fig. 3 while it extends more nearly in a straight line with the basal

portion of the vein in Fig. 1. The fore wing of an Aphid (Fig. 7) however, is more like that of a Psocid (Fig. 8) than that of a Zorapteron (Fig. 11), and the nature of the veins A., and "Cu_2" of Fig. 8 is very suggestive of the condition exhibited by these veins in Fig. 7. The incomplete vein "R_s" of Fig. 8 is also very suggestive of vein "R_s" of Fig. 7; but the point of origin and the extent of vein "M" of Fig. 8, is somewhat different from that of the vein bearing the same label in Fig.7. On the whole, however, the resemblance between the types of wings shown in Figs. 7 and 8 is very striking, and adds further weight to the evidence drawn from other sources indicating that the Psocids represent as nearly as any living forms, the ancestral types from which the Aphids and other Homopterous insects were derived.

The venation of the fore wing of the Psocid shown in Fig. 2 approaches remarkably closely the type of venation occurring in the Thysanoptera;* and since it furnishes us with the basis for determining the homologies of the Thysanopteron venation, it is of considerable importance to make as accurate a determination of the venation of the Psocid in question as it is possible to do from the evidence at hand. A comparison of *Embidotroctes* (Fig. 2) with *Embidopsocus* (Fig. 4) which is slightly less modified than the former insect, would indicate that branch "R_{4+5}" is either lost, or coalesces with "R_{4+5}" (Fig. 4) to form the terminal portion of the vein labeled "R " in Fig. 2. I am more inclined to consider that vein "R_{4+5}" of Fig. 4 is lost, in Fig. 2 ; and hence the terminal portion of vein "R_s" of Fig. 2 would be formed by "R_{4+5}" alone. The reason for so thinking is that in the fossil Thysanopteron *Palaeothrips fossilis*, the terminal portion of a similar vein appears to be formed by "R_{4+5}", while vein "R_{2+3}" becomes vertical, and takes on the appearance of a cross vein connecting it with the anterior margin of the wing. This matter, however, will be discussed more at length in a subsequent paper, and need not be further considered here. It may be remarked in passing that the terminal portion of vein "M" of Figs. 2 and 4, is probably composed of "M_1", as is indicated by the labelling.

The principal points brought out in the preceeding discussion may be briefly summarized as follows. The Psocids are much nearer the Zoraptera than has formerly been supposed to be the case, and so far as the wing veins are concerned, the Psocid family Caeciliidae approaches the Zoraptera much more closely than any other known insects, the wings of the Psocid *Archipsocus brasilianus* (Fig. 10) being remarkably like those of the Zorapteron *Zorotypus snyderi* (Fig. 12) while the wings of the Psocid *Archipsocus recens* (Fig. 9) are remarkably like those of the Zorapteron *Zorotypus hubbardi* (Fig. 11). In both groups of insects there is a tendency to form a pterostigma "ps", and there is also a tendency toward the formation of a thickening of the margin of the wing to form a sort of "ambient" vein like that found in the Thysanoptera. In both Zorapteron and Cæciliid fore wings, the vein "R_{2+3}" tends to curve forward toward the anterior margin of the wing, and vein "M" is unbranched, and tends to bend backward toward the posterior margin of the wing. Vein "Cu" is two branch-

* The veins labeled "M" and "Cu_1" in Fig. 3 of the fossil Thysanopteron described in Ent. News Vol. 32, p. 97, should be labeled "M_1" and "M_2", judging from the evidence furnished by a study of the wings discussed in the present paper.

ed in both groups, in the fore wing, and is unbranched in the hind wing. The course of veins "R_{2+3}" and "M_2" is astonishing similar in the hind wings of both types of insects.

While it has no direct bearing on the matter of indicating a close relationship between the two groups, it may be mentioned that in the Psocids there is a marked tendency toward the development of aberrations in the venation of certain individuals, and the venation of the wing of one side of the body may even differ from that of its fellow on the other side of the body. Similarly in the Zoraptera, there is also exhibited a marked tendency toward a variation in the venation of certain individuals, and in a specimen of *Zorotypus snyderi* which I have examined, the venation of the right fore wing was quite different from that of the left fore wing, thus suggesting the operation of similar tendencies in the two groups of insects.

The evidence of the wing venation would add further support to the indications of an extremely close relationship between Zoraptera and Psocids furnished by other features of the body, and this relationship is so intimate that it is quite evident that the Zoraptera should be placed in the superorder Panhomoptera next to the Psocids. Furthermore, the Zoraptera are the nearest living representatives of the types ancestral to the Psocids, and these in turn are very like the ancestors of the Thysanoptera, Mallophaga, Anopleura, Hemiptera and Homoptera.

The orders of winged insects may be grouped into the following superorders, according to the revised views expressed in an article recently published in Psyche, Vol. 27, 1920, p. 125, which are further modified to a slight extent, in the following list.

Palaeodictyopteriod Superorder (Panpalaeodictyoptera or Ephemeriformia).... Protephemeroida, Ephemeroida, Protodonata, Odonata, Palaeodictyoptera, "Protohemiptera" etc.

Plecopteroid Superorder (Panplecoptera or Perliformia)..... Haplopteroida, Plecoptera, Hadentomoida, Embioida, Dermaptera, etc.

Orthopteroid Superorder (Panorthoptera or Phasmiformia)..... Protorthoptera, Grylloblattoida, Phasmoida, Orthoptera, etc.

Isopteroid Superorder (Panisoptera or Blattiformia)..... Protoblattoida, Blattoida, Mantoida, Isoptera, etc.

Psocoid Superorder (Panhomoptera or Psociformia)..... Zoraptera, Psocoida, Mallophaga, Pediculoida, Thysanoptera, Homoptera, Hemiptera, Palaeohemiptera, etc.

Neuropteroid Superorder (Panneuroptera or Sialiformia)..... Neuroptera, Hymenoptera, Mecoptera, Protomecoptera, Paramecoptera, Paratrichoptera, Trichoptera, Lepidoptera, Diptera, Siphonaptera, etc. The Coleoptera and Strepsiptera may eventually be placed in this superorder, but I have not been able to definitely decide concerning them or such forms as the Megasecoptera, etc., which are also related to members of this superorder.

The Plecopteroid superorder appears to lead to the Neuropteroid superorder, while the Isopteroid superorder appears to lead to the Psocoid superorder,

in some respects. The Orthopteroid superorder is somewhat intermediate between the Isopteroid superorder and the Plecopteroid superorder with its closest affinities very slightly nearer the former, though the balance between the Isopteroid and Plecopteroid characters in the Orthopteroid group is fairly evenly divided. The Isopteroid and Plecopteroid superorders are both very close to the Palaeodictyopteroid group, which may represent the common ancestors of both.

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Abbreviations.

The numerals written to the right and below the letters indicate branches of the veins referred to. A plus sign between letters indicates a coalescence of the veins in question.

al....Anolobus or anal lobe (vestigial anoflabellum, or anal fan of lower insects).

A....First anal vein.

ap...Anoplica, or anal fold.

as...Anosinus, or anal sinus.

ax...Axillary vein (second anal).

ch...Costahamus, or costal hook.

Cu..Cubitus.

M...Media.

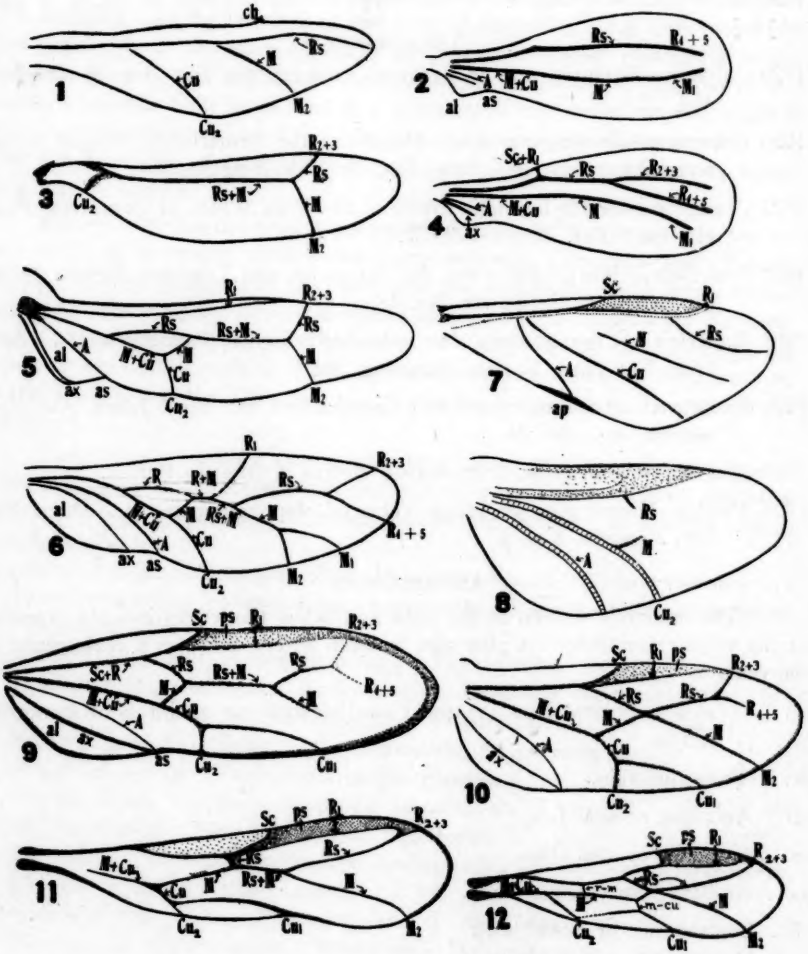
ps...Pterostigma.

R...Radius.

R_s..Radial sector.

Sc...Subcosta.

Can. Ent., Vol. LIII. Plate III



COMPARISON OF WINGS OF ZORAPTERA, PSOCIDS AND APHIDS.

(See page 117)

EXPLANATION OF PLATE III.

Figures 2, 4, 5, 6, 8, 9, and 10 are based on figures by Escherich. Figures 1 and 7 are based upon figures by Patch, 1909.

Fig. 1...Right hind wing of Aphid *Macrosiphum solanifolii.*
Fig. 2...Right fore wing of Psocid *Embidotroctes paradoxus.*
Fig. 3...Right hind wing of Zorapteron *Zorotypus snyderi.*
Fig. 4...Right fore wing of Psocid *Embidopsocus luteus.*
Fig. 5...Right hind wing of Psocid *Archipsocus recens.*
Fig. 6...Right hind wing of Psocid *Psyllipsocus ramburi.*
Fig. 7...Right fore wing of Aphid *Pamphigus venafuscus.*
Fig. 8...Right fore wing of brachypterous form of Psocid *Archipsocus brasilianus.*
Fig. 9...Right fore wing of Psocid *Archipsocus recens.*
Fig. 10..Right fore wing of Psocid *Archipsocus brasilianus.*
Fig. 11..Right fore wing of Zorapteron *Zorotypus hubbardi.*
Fig. 12..Right fore wing of Zorapteron *Zorotypus snyderi,* after Crampton, 1921. This wing should be of same size as that of the Zorapteron shown in Fig. 11.

TWO NEW CANADIAN MAY-FLIES (EPHEMERIDAE).

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In the second week of June, 1920, I collected from the underside of the leaves of an ash tree, situated near the banks of the Rideau river a number of specimens of both sexes of those tiny May flies belonging to the genus *Baetis.* At the time I supposed I was collecting *Baetis pygmaea* Hagen, but a careful study of the entire material at a later date convinced me that three species were represented and could be fairly readily distinguished, even in a dried condition, by the relative size of the superior, reddish portion of the eyes.

It became necessary therefore to determine whether the true *pygmaea* was represented in my catch and specimens of all three species were submitted to Dr. Nathan Banks of the Cambridge Museum, Mass. Dr. Banks was kind enough to compare these specimens carefully with the remains of the type ♀ of *B. pygmaea* (one wing and a portion of thorax) as well as with the type ♀ of *B. unicolor* Hagen and co-types of *B. propinquus* Walsh. One of the species he definitely identified as *propinquus,* the other two he reported as probably new, both being considerably larger than *pygmaea* and showing constant differences in venation, notably in the hinder portion of the wing.

Unicolor was described from ♀'s only, collected in Washington, D. C., and until the correct ♂'s can be definitely associated with the opposite sex, identification of this species must remain doubtful. The same is more or less true of *pygmaea;* the type locality is given as "St. Lawrence River" and until we have more definite knowledge of the *Baetis* forms inhabiting this river, it would be mere guess work, in view of the very close superficial resemblance between the

*Contribution from the Entomological Branch, Dept. of Agriculture, Ottawa.

species of this group, to associate the name definitely with any of our Ottawa species. The only other name in this genus which might possibly have been applied to our forms was *rubescens* Prov., a species unknown to Dr. Banks. Through the kindness of Canon Huard I have received for study the only two species in the Provancher Collection labelled with this name in Provancher's handwriting; one specimen, a ♀, is very evidently not the type nor even correctly associated; it is a species of *Chirotenetes*. The other, a ♂, agrees well with Provancher's short description, having the costa and base of primaries and a good portion of the secondaries tinged with ruddy colour. It does not however belong in the genus *Baetis* but in *Baetisca* and is apparently distinct specifically from *obesa* Say, the sole species at present included in the genus. I propose making this specimen the Lectotype and transferring the specific name to the correct genus.

In view of the above facts it seems advisable to give names to the two unknown species; the ♂'s may be separated from one another as follows:—

a. Superior eyes large, kidney-shaped; intercalaries on primaries well developed, especially between subcosta and radius..*intercalaris*, n. sp.

a' Eyes smaller, oval; intercalaries between subcosta and radius either faint or entirely lacking.

b. Superior eyes moderate, roundly oval; thorax of ♂ shiny black .....*propinquus* Wlsh.

b' Superior eyes small, lengthily oval; thorax brown with distinct lateral yellow spot on prothorax extended backward by a line to base of wing.....*flavistriga, n. sp.*

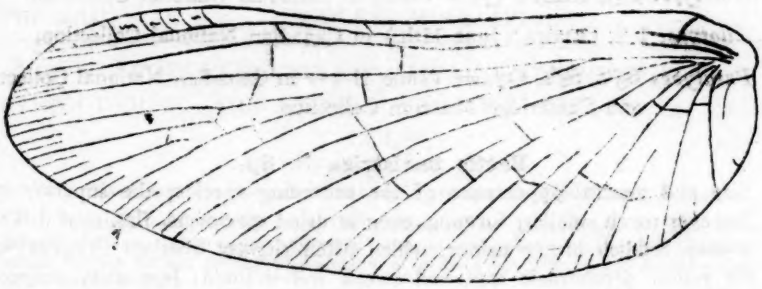
All the species agree in the ♂ sex in the type of abdominal marking, the first and the last three segments (apart from genitalia) being brown, the remainder hyaline white with black stigmatal dots. A detailed description of the new species follows:—

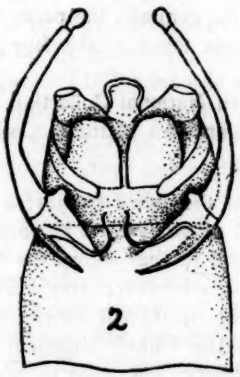
Baetis intercalaris N. Sp.

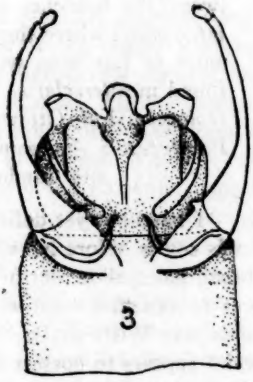
♂. Length of wing (from center of thorax to wing tip) 5 mm; length of body 4½ mm; length of abdominal setae 9-10 mm. Legs pale yellowish, antennae blackish at base shading to whitish at tips; lower eyes black; superior eyes large, brownish red, kidney-shaped, pale around the rims, which in dried material are usually curled up. Thorax black-brown, slightly marked with yellowish on the dorsal protuberances and with a yellowish lateral prothoracic line extending to base of wing; abdomen with basal segment dull brown, last three segments ruddy-brown dorsally; remaining segments pale yellowish white; beneath all segments but the first uniformly whitish; genital organs pale; setae white. Wings with the intercalaries on primaries well marked, the two in the interspace between subcosta and radius particularly long; cross-veins between branches of cubitus distinct.

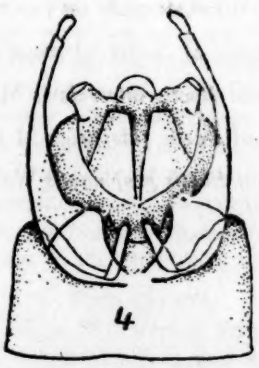
In the genitalia the penes are curved, rod-like, tapering to a very fine point, slightly bent at tip.

♀. Eyes small, wide apart, blackish; face variegated brown and yellow; dorsum of thorax slaty-black, laterally and abdominally brownish; abdomen brownish above, dull yellowish gray below; setae dirty white, duller than in ♂; legs









NEW CANADIAN MAY-FLIES

(See page 117)

deeper in colour than in ♂; venation similar to that of ♂.

Holotype. 1 ♂, Ottawa (June 11th,) in Canadian National Collection.

Allotype. 1 ♀, Ottawa (June 11th.) in Canadian National Collection.

Paratypes 6♂'s, 6♀'s, Ottawa (June 11-14) in Canadian National Collection and Cambridge Museum Collection.

Baetis flavistriga N. Sp.

♂. Size and general appearance of the preceding species; the superior eyes however much smaller, forming, even in dried specimens, flat, oval disks of a deep reddish brown colour, which often slightly overlap. Thorax with the yellow prothoracic spot and streak well-defined; legs dirty ochreous. Primaries with the intercalaries less developed than in the preceding species, those between subcosta and radius being much shorter; the cross-veins between the branches of the cubitus are also quite faint in distinction to *intercalaris* where they are well-developed. In the genitalia the penes are of more or less even width throughout and do not taper to the fine points found in *intercalaris*.

Holotype. 1 ♂, Ottawa (June 14th) in Canadian National Collection.

Paratypes. 5 ♂'s, same locality and date, in Canadian National Collection and Cambridge Museum Collection.

I have not yet definitely associated the ♀'s of the above species; a series of this sex is before me which differs from the ♀'s of *intercalaris* in possessing a broad pale yellow dorsal stripe on the abdomen and further shows the differences in venation mentioned above. These specimens however may belong to *propinquus* Wlsh. as Dr. Banks mentions to me that the female cotype of this species appears to possess such a stripe. In view of this I have thought it better to leave the matter in abeyance until such time as further collecting or breeding can settle the doubt.

EXPLANATION OF PLATE.

Fig. 1 Venation of forewing of *Baetis intercalaris* McD.

Fig. 2 Male appendages of *Baetis intercalaris* McD.

Fig. 3 Male appendages of *Baetis flavistriga* McD.

Fig. 4 Male appendages of *Baetis propinquus* Walsh.